

Remus Teodorescu received the Dipl.Ing. degree in electrical engineering from Polytechnical University of Bucharest, Romania in 1989, and PhD. degree in power electronics from University of Galati, Romania, in 1994. In 1998, he joined Aalborg University, Department of Energy Technology, power electronics section where he currently works as a professor. He has more than 180 papers published, 1 book ("**Grid Converters for Photovoltaic and Wind Power Systems**", ISBN-10: 0-470-05751-3 – Wiley) and 4 patents. He is a Senior Member of IEEE, Past Associate Editor for IEEE Trans on Power Electronics and chair of IEEE Danish joint IES/PELS/IAS chapter.

He is the founder and coordinator of the Green Power Laboratory at Aalborg University focusing on the development and testing of grid converters for renewable energy systems. He is the coordinator of Vestas Power Program, involving 10 PhD students and guest professors in the areas of power electronics, power systems and energy storage. His areas of interests are: design and control of power converters used in photovoltaics and wind power systems, grid integration with wind power, medium-voltage converters, HVDC/FACTS, energy storage systems.

Josep M. Guerrero received the B.S. degree in telecommunications engineering, the M.S. degree in electronics engineering, and the Ph.D. degree in power electronics, in 1997, 2000, and 2003, from the Technical University of Catalonia, Barcelona, Spain. He is an Associate Professor at the same university, where he teaches courses on digital signal processing, control theory, and renewable energy systems. Since 2004, he has been responsible for the Renewable Energy Lab, Escola Industrial de Barcelona. His research interests include photovoltaics, wind energy conversion, uninterruptible power supplies, storage energy systems, and microgrids.

Dr. Guerrero is an Associate Editor of the IEEE Transactions on Industrial Electronics, the IEEE TRANSACTIONS ON POWER ELECTRONICS,

and the Editor-in-Chief of the International Journal of Integrated Energy Systems. He is the Guest Editor-in-Chief of the IEEE TRANSACTIONS ON POWER ELECTRONICS for the Special Issue: "Power Electronics for Microgrids". Currently, he chairs the IEEE Industrial Electronics Society Technical Committee on Renewable Energy Systems.

Tamas Kerekes obtained his Electrical Engineer diploma in 2002 from Technical University of Cluj, Romania, with specialization in Electric Drives and Robots. He received his MSc and PhD degree in 2005 and 2009, at Aalborg University. Currently he is working as an Assistant Professor at the same Department. His main interest is on PV inverter modelling, control and topologies as well as modulation techniques with focus on transformerless PV inverter systems.

Juan C. Vasquez received the B.S. degree in Electronics Engineering from Universidad Autonoma de Manizales, Colombia in 2004 where he has been an Assistant professor teaching courses on digital circuits, Servo systems and flexible manufacturing systems. He received the PhD degree from the Technical University of Catalonia, Barcelona, Spain in 2009, where he teaches courses on renewable energy systems. His research interests include modelling, simulation, and power management applied to Distributed Generation in Microgrids.

Fee

The fee is 9000 DKK for industry people and 6000 DKK for academia and PhD students outside Denmark. The fee includes coffee, lunch for all days and copy of slides and simulation models on a USB key

Credits 3.0 ECTS

Registration

<http://phdcourse.aau.dk/index.php?list=29586>



Microgrids

Industrial/PhD course on Microgrids
in Theory and Practice

**Industrial/Ph.D. Course in
Microgrids
- in theory and practice**

Oct 31 – Nov 2, 2011



**Department of Energy Technology
Aalborg, Denmark**

Background of the course

Worldwide electrical grids are expecting to become smarter in the next future. In this sense, the increasing interest in intelligent microgrids able to operate in island or connected to the grid, which will be a keypoint to cope with new functionalities, as well as integration of renewable energy resources.

A microgrid can be defined as a part of the grid with elements of prime energy movers, power electronics converters, distributed energy storage systems and local loads, that can operate autonomously but also interacting with main grid. The functionalities expected for these small grids are: black start operation, frequency and voltage stability, active and reactive power flow control, active power filter capabilities, and storage energy management. This way, the energy can be generated and stored near the consumption points, increasing the reliability and reducing the losses produced by the large power lines.

The course starts giving some examples of microgrid in the world. The course is focused on single and three-phase voltage source inverters and rectifiers. The modeling, control and stability of these power electronics converters is presented using practical exercises. Concepts like frequency and voltage droop control are explained in detail, as well as the virtual impedance concept.

This course also introduces the study of the hierarchical control of microgrids for DC and AC electrical systems. Secondary control issues are introduced to regulate frequency and amplitude voltage of the microgrid. Finally, tertiary control issues, synchronization and grid interactivity between the grid and the microgrid are analyzed. Finally, the concept of decentralized power quality compensation is presented.

Control design experience will be gained by using advanced simulation models in Matlab-Simulink for grid converters. Hands-on experience will be provided in the state-of-the-art Green Power Laboratory, where all the participants will make experimental tests on PV array modeling, characterization and diagnostics, MPPT, anti-islanding, grid interaction using setups controlled by dSPACE (DS1103).

No less than 40% of the course time will be spent in the lab

Keep yourselves updated at www.et.aau.dk

Accommodation and transport

For hotel, transport information and booking please check: www.et.aau.dk/phd/phd-courses

Place

Aalborg University, Department of Energy Technology
Pontoppidanstraede 101, Room 23
DK-9220 Aalborg East, Denmark

Language

English

Prerequisites

A degree in electrical engineering or control engineering and Matlab/Simulink knowledge is strongly recommended.

Literature

Printed copy of the slides and laboratory handbook will be provided along with a USB key including all slides and simulation models.

Further information

Prof. Remus Teodorescu
Aalborg University, Department of Energy Technology
Phone +45 9940 9249, Email: ret@et.aau.dk

Day 1, 08.30-16.30

- L1 Microgrids systems Overview
- L2 Distributed Storage systems
- L3 Control of voltage source inverters for Microgrids
- Lab I Design of control inner loops for VSI
- Lab II Experimental evaluation of a stand-alone VSI with voltage control
- Lab III Demonstrative example of Aalborg University microgrid

Day 2, 08.30-16.30

- L4 Droop control and virtual impedance concept

- L5 Hierarchical control of ac microgrids
- L6 Distributed reactive power compensation in ac microgrids
- L7 Distributed Power Quality improvement in ac microgrids
- Lab IV Design of droop control and virtual impedance
- Lab V Experimental evaluation of grid-interactive VSI with droop
- Lab VI Experimental evaluation of an islanded microgrid based on two three phase voltage source inverters with Q comp
- Lab VII Experimental evaluation of power quality issues in ac Microgrid

Day 3, 08.30-16.30

- L8 Control of power converters for dc microgrids
- L9 Hierarchical control of dc microgrids
- L10 Stability of dc microgrids
- L11 Applications of dc microgrids
- Lab VIII Design of control for converters for dc microgrids
- Lab IX Experimental evaluation of stand-alone converter with dc voltage control
- Lab X Experimental evaluation of dc microgrid with 2 converters and droop control
- Lab XI Experimental evaluation of hierarchical control in dc microgrids

Lecturers

Remus Teodorescu, Professor, Aalborg University, Denmark, ret@et.aau.dk

Josep M. Guerrero, Associate Professor, Technical University of Catalonia, Spain, josep.m.guerrero@upc.edu

Tamas Kerekes, Assistant Professor, Aalborg University, Denmark, tak@iet.aau.dk

Juan C. Vasquez, Post-doc Assistant, Technical University of Catalonia, Spain, juancho.vasquez@gmail.com